FORESTRY
IN THE
PACIFIC NORTHWEST

A REFERENCE HANDBOOK
FOR
C.C.C. FORESTRY CLASSES

PREPARED BY
THE SECTION OF EDUCATION AND INFORMATION

NORTH PACIFIC REGION
PORTLAND, OREGON.

1935

"A people without children would face a hopeless future; a country without trees is almost as helpless; forests which are so used that they cannot renew themselves will soon vanish, and with them all their benefits. When you help to preserve our forests or plant new ones you are acting the part of good citizens".

Theodore Roosevelt.

Nov. - 1935 - 1500
Apr. - 1936 - 1000

SUGGESTIONS FOR INSTRUCTORS

This elementary forestry course, for use in Civilian Conservation Corps camps, contains subject matter which will enable the individual as a citizen to become better informed in regard to forestry in the Pacific Northwest. For those who are considering forestry as a life work it provides some measure of orientation. It differs from similar booklets in that the course as set forth is of the reading reference type instead of in correspondence form.

It is intended to fulfill the purpose of a text book and should be presented with this thought in mind. The questions that will be found at the end of each chapter may be answered in any manner the instructor sees fit. They are of the test questions type and cover only the material found in the preceding chapter. In preparing each question an attempt was made to keep it broad enough to stimulate a recitation, or to prepare a written paragraph or two on each. Additional questions may be supplemented if the instructor so desires.

It is suggested that the reference material listed be used as much as possible in the presentation of this course.

FORESTRY IN THE PACIFIC NORTHWEST

A reference handbook for CCC Forestry Classes

I. Introduction
   1. Purpose and scope of this booklet
   2. Forestry defined

II. The Social and Economic Importance of Forests in the Pacific Northwest
   1. Forestry and Land Use Planning
   2. Forest Values

III. The Forest Types of the Pacific Northwest
   1. The Douglas fir region
   2. The Ponderosa pine region

IV. Identification and Uses of the More Important Pacific Northwest Trees

V. Sustained Yield and Selective Logging
   1. What Is Sustained Yield?
   2. What Is Selective Logging?
   3. Selective Logging in Pine
   4. For the Douglas Fir Region
   5. What Is Reforestation?

VI. The Importance of Forest Fire Prevention
   1. Objectives in Forest Fire Prevention
   2. Reduction of Man-Caused Fires
   3. Educational Effort
   4. The Mark of the Woodsman
   5. What about Light Burning

VII. Forest Improvements and Work Projects
   1. Relationship of Forest Improvements to Fire Control
   2. The CCC and Project Planning

VIII. The Forestry Organizations of the Pacific Northwest
   1. The Federal Reforestation Act
   2. The U. S. Forest Service
   3. The States
   4. Forest Industries and Associations

IX. Appendix
   1. A brief Historical Outline of the U. S. Forest Service
   2. Summary of State Forestry Laws of Washington and Oregon
   3. Bibliography and References

FORESTRY IN THE PACIFIC NORTHWEST

A reference handbook for CCC Forestry Classes

- - - -

I. INTRODUCTION

1. Purpose and Scope of this Booklet.

The men in the CCC camps today will become the business, professional and industrial workers of the future. Each has his own interests; one vocation or another is the goal toward which he is, or should be, working. But whatever the vocation chosen, certain subjects are basic to successful citizenship. Here in the Pacific Northwest, forestry is one of these. The natural resource of forest products and water power have had a profound effect upon the development of this part of the country. Practically all other lines of business are dependent, directly or indirectly, upon the condition of the forest industries for their own prosperity. Men who have been in the CCC camps, by reason of their close association with forestry and conservation, should be particularly interested in the present and future trends of forestry. By the time they reach mature life, and are taking an active part in the affairs of the community, state or nation, forestry problems doubtless will be more acute than they are today.

Even today, the wise use of forest lands has been dramatized to a dominant role in the American scene. Here the Civilian Conservation Corps is playing an important part. It is hoped that the day of ruthless forest devastation is definitely passing. Sustained yield forestry and adequate forest protection are established as the worthwhile goal towards which we should work.

It is generally recognized that labor, applied to land or the products of the land, produces wealth. Here in the Pacific Northwest, where a large part of the land is suited only for forest growing, it is labor, acting upon the forest crops of the soil, which produces the basic wealth of the region. It follows then that every well-informed citizen, especially in these states, should know something about forestry, and be able to discuss the subject intelligently. Men who have served in the CCC camps, particularly, will be expected by their friends and neighbors to be well posted in regard to forestry and woodsmanship.

It is the purpose of this booklet to supply some of this information, especially as it pertains to the Pacific Northwest. In a manner speaking, it will be an opening of windows leading to larger vistas of thought and action. References will be given for those who

desire to delve more deeply into any of the subjects presented. It is not the aim of these suggestions to produce technical or professional foresters. That properly is the work of the schools and colleges of forestry. Full professional training in forestry cannot be accomplished within the time and resources available in the CCC camps, - no more than a man could hope to become a full fledged doctor of medicine after taking the first aid course. The course, however, can serve a valuable purpose in helping some men to get oriented and to decide whether or not they wish to meet the requirements for entering the forestry profession. To those who can and will spend the necessary time and effort preparatory to qualifying for this most fascinating, yet exacting, profession, we wish you the best of luck.

2. Forestry Defined.

Webster defines forestry as "The science and art of forming, caring or cultivating forests; the management of growing timber". Perhaps we should expand this definition by stating that forestry is the management of land for the growing of trees and other forest products for human use. It means the growing of timber on land best suited for that purpose. It is the aim of forestry to keep such land busy continuously in the production of timber and other forest values for the benefit of mankind. While lumber and related wood products are the forest values which come first to mind, the forests of our country supply other needs of almost equal importance. In addition to furnishing repeated crops of timber, tree and brush covered areas are managed so as to conserve water for drinking, power, navigation and irrigation. Forests protect wild animal, fish and bird life, and provide wholesome recreation, so necessary in these modern times.

A well managed forest might, in a way, be compared to a well managed farm. The wise farmer plans for a diversity of crops, both animal and vegetable. He plans for the best use of the soil, and the conservation of soil values. He makes his farm a pleasant, attractive place to live. In the forest, as on the farm, we see a complex picture of various uses and values, flexible to meet changing demands, and yet closely related and balanced.

The forester must be well versed in a number of sciences relating to tree growth and land management. He must have acquired the art of forestry through long study and practice. And he must bring business principles to bear in the management of the forest property entrusted to his care. Forestry, therefore, may be classified as a science, an art and a business.

Graves and Guise, in their book "Forest Education" (Yale University Press, 1932) state: "The utilization of various sciences and arts by the forester has created misconceptions as to his exact

position among the professions. The forester is not a trained engineer, though he must have knowledge of mathematics and certain aspects of engineering; and forestry is not a branch of engineering. Likewise, forestry is not a branch of agriculture, though both agriculture and forestry are based on the same biological sciences. The forester is not a professional economist, though he deals with certain phases of applied economics. The forester is a specialist in forest science, dealing with a distinctive and unique problem, the solution of which requires a highly organized body of knowledge and a specialized technique."

QUESTIONS (Chapter I)

1. Toward what objectives should the forester of today strive?

2. What is the aim of forestry? Why is it so important?

3. A business man wants to know what forestry is. How would you explain it so that it would be clear in his mind?

4. Same assumption as question 3. Define a forester.

II. THE SOCIAL AND ECONOMIC IMPORTANCE OF THE PACIFIC NORTHWEST FORESTS.

1. Forestry and Land Use Planning.

Planning for the wise use of land is a significant development of the new conditions under which we live. It will play an important part in shaping the new American mode of living. Many of the present day American problems have their roots in an unplanned and unwise use of land and its resources.

When we approach the subject of land use planning in the Pacific Northwest, we find forestry and forest lands occupying a prominent place in the picture. Nearly one half of the production income, employment and payrolls come directly from the timber industry. The other industries and general business prosperity largely depend on the state of the forest products industries. West of the Cascade range, perhaps half or more of our area is suited for forest growth, and that alone. In eastern Oregon and Washington a large portion of the productive land can produce only forest crops of one kind or another.

The mere production of lumber, however, is not the whole of forestry. Although timber cropping is highly important, other products, such as watershed protection, forage, recreation, and fish, game and wildlife have large social and economic significance. Agriculture, forestry, range use and water resource use must be brought into balance if we are to go forward sanely in the development of proper living conditions.

One of the great problems of this region has been the increasing areas of so-called "no man's land" as the result of destructive logging of great tracts of privately owned forests. This is bringing about here the same series of events which the Lakes States went through. The logging industry came; substantial towns sprang up; railroads were built; agriculture prospered. The timber was cut out and the industry moved on. As a result, towns decayed; railroads were pulled up; farms became unprofitable when the market left them. Tax delinquency added to state and county problems. Socially, the result of such a situation is a shifting, discontented population, and economic disaster. Sustained yield forest management, as discussed in a later section of this booklet, points the way to a solution of these problems. In a region so productive and so dependent on one resource, - forests - as is the North Pacific region, the need of keeping our forest land permanently productive is apparent. This stabilization is one of the purposes and effects of management for sustained yield.

Another serious problem here, which must enter into land use planning is the use of what is known as "sub-marginal farm land". A large part of our timbered region is not suitable for agriculture, but is liberally sprinkled with families trying to make a living by farming. Ill advised and unplanned use of forest land for farming has several disadvantages. The expense of furnishing roads and schools for such farms must be borne by other property. The increased tax burdens add to tax delinquency. Sub-marginal farming produces low social standards, with a drifting population and the privations of poverty. Pauper farming and rural slums are inevitable under this method. This region cannot afford the continual loss from misguided efforts of people with energy and some accumulated savings attempting to farm inaccessible and low quality lands.

Classification of land areas suitable only for forest is the remedy for this situation. This should be followed by the gradual transfer of the population to lands in approved agricultural districts. Ultimately, there should be a policy of refusal to build or maintain schools or market roads in these forest districts. Such steps, if taken in an orderly and well planned manner, would relieve many of the difficulties.

2. Forest Values.

Having defined forestry, and considered the place of forestry in land use planning, let us now consider some of the values which the forests contribute to our economic and social life. Foresters generally group these under the following main headings: Wood crops; watershed protection; recreation; game and wild life; and forage for domestic livestock.

a. Wood Crops. Dr. Fernow states ("Economics of Forestry", B. E. Fernow, LL.D., Crowell & Co., 1902) that "outside of food products no material is so universally used and so indispensable in human economy as wood. Indeed, civilization is inconceivable without an abundance of timber".

A little reflection will show this to be true. Consider our wooden houses and furniture, the wooden packing boxes in which our food is shipped and the wooden railroad ties over which that food is hauled. All the way down through the list of commodities,- pencils, paper, telephone and telegraph poles, mine props, boats, farming implements, furniture, musical instruments, - all of these necessities and hundreds more depend, either directly or indirectly, upon a plentiful supply of forest products. New uses are being developed in the wood pulp, wood chemical, and other similar industries. Mining, transportation, and agriculture each make enormous demands upon the forest for necessary material.

b. Watershed Protection. Through irrigation and hydro-electric power, water has been and still is one of the important economic forces in the development of the West. It enters also as an economic factor in the form of domestic and city drinking water, and in navigation.

All of these things are dependent upon protected watersheds. The term "watershed" as used in forestry, should be understood. The forested hillside is a natural reservoir. It receives the rain and snow, and gives it out little by little in the form of steady stream flow. Water falling on a barren hillside rushes off in a flood, carrying with it soil, rocks, and debris. By reason of this erosion, silt and mud clog reservoirs and irrigation ditches, destroy farm lands, grazing lands, damage electric power plants, pollute home drinking water, and eventually hinder navigation. Watershed protection, therefore, is an important economic phase of forestry. Young tree growth and underbrush, which may have no value for timber or recreation, may still play an important part in our civilization by preventing erosion.

c. Forage. Many forest regions are interspersed with open, grassy meadows, or weed-covered areas. If unused, these forage plants die, or dry up and become a forest-fire hazard. In addition to the fire menace, this also is an economic waste. Where other important interests of the forest are not endangered, it is wise to use this forage for the grazing of sheep and cattle. Thus a waste is converted into important by-products of wool, meat and leather. Grazing use of the forests must, however, be regulated carefully, and coordinated with other important demands. Otherwise, the young forest growth, as well as the forage crop, may be damaged or destroyed by overgrazing or improper use. The grazing use of the forests is more important in the ponderosa pine forests east of the Cascade Range than in the heavy fir forests of the Coast region.

d. Recreation. Forest recreation now is recognized as having distinct economic and social values. Rest and change of environment are necessary in our complex modern civilization, and our citizens turn naturally to the forested regions for these things. Preservation of scenic beauty, protection of fish, game, and wild life, and stopping of the smoke nuisance are essential if the forest recreation resource is to continue to be used. The lure of the forested mountains also has helped to create the tourist industry. This is bringing an ever-increasing flow of tourist dollars into the Western states.

e. Game and Wild Life. Fish, game, and wild life constitute a [illegible] on the forest. In addition to its esthetic appeal, this resource is a definite economic factor. It contributes food and fur. The lure of wild life helps to draw and to hold the outside tourists and local summer visitors. The expenditures of these people contribute to the local income.

The forest and brush furnish cover and breeding grounds for birds and wild animals. Forest fire is the great enemy of the wilderness creatures and even light woods-burning has disastrous effects on a continuance of the game resource. In addition, the burning of watershed forests often pollutes and fills up streams and lakes and eventually destroys the fish.

QUESTIONS (Chapter II)

1. What part does forestry play in land use planning?

2. What must be done with our land to bring proper living conditions into balance?

3. Explain what happened in the Lake States Region and tell how we can avoid the same condition in our region.

4. What is sub-marginal farming and how does it affect society?

5. List the forest values as set forth in this booklet.

6. Why are wood crops so important?

7. What is a "watershed"? How does forestry affect its existence?

8. Is recreation essential to forest protection and development? Why?

III. FOREST TYPES OF THE PACIFIC NORTHWEST

The forests of Oregon and Washington are divided roughly into two regions, which differ as to climate and tree growth. From the slopes of the Cascade Range westward to the ocean are the dense coast forests of Douglas fir, western hemlock, Sitka spruce, and western red cedar. East of the Cascades are the open, parklike ponderosa pine forests. Between these two at the higher elevations of the Cascade Range are the alpine woodlands, largely of mountain hemlock and the balsam firs. These alpine areas are of low timber value, but are important for protecting the headwaters of streams, for grazing and for recreation.

Oregon and Washington contain almost one half of the remaining merchantable coniferous timber of the United States. While Oregon contains 26% of the total remaining timber and Washington 19%, Washington is the leading state in the annual amount cut.

1. The Douglas Fir Region.

This region is the most important one in Oregon and Washington. It lies between the Pacific Ocean and the crest of the Cascade Range, which extends from British Columbia approximately to the California line. Except for a few meadows, prairies, and mountain barrens the entire region once was forest clad. Although the timber cut is large, it promises continued large cuts for many years.

The Douglas fir region has 82% or over 29,000,000 acres of its total area classed as forest land; of which about 4,000,000 acres have been logged. This region supports a timber stand of 546 billion board feet.

By no means, however, is every acre that is best suited to the growing of timber, bearing the quota of timber that it might. It is estimated that on the advent of the white man, the whole region was not bearing more than a third of the timber the land was capable of producing. The average stand for the region as a whole was probably under 30,000 board feet per acre, whereas mature timber ought to average about 100,000 f. b. m. per acre. Large areas were denuded or bearing small timber, and other areas were thinned out and patchy because of the inroads of fire.

Serious fires from time immemorial have wrought great havoc in the virgin forest, which when destroyed has usually been replaced by a second-growth forest. Thus there is in this region, timber of various age classes. There are entire townships of

immature timber, and the existence of such areas has an important bearing on the future stability of the forest industries of this region.

Extensive lumbering operations are as yet almost wholly in mature timber. Of the entire lumber cut in this region, excluding cedar shingles, 82% is Douglas fir. Of the 261 billion f. b. m. of privately owned timber, at least 60% is Douglas fir. Although Douglas fir predominates, it is by no means the only important species. It does, however, occur on nearly every site, and the physical differences between the high and low elevations, between coastal, valley and mountain sides, are reflected in pronounced differences in the forest cover.

2. Ponderosa Pine Region.

The ponderosa pine region embraces the region east of the Cascades in Oregon and Washington. It comprises about 10,000,000 acres of forest land, or about 40% of the entire forested area of the two states. Ponderosa pine predominates. In fact this species covers a larger total area than any other conifer in the western part of the United States; and endures a wider range of physical conditions than any other pine. Its principal associates are: Lodgepole pine, sugar pine, white fir, lowland white fir, Douglas fir, and western larch. Its associates of lesser importance are: Incense cedar, western red cedar, western juniper, and Rocky Mountain red cedar.

Not all of the component species listed are represented in equal degree in each part of the region. For instance, sugar pine and incense cedar are found only in the southern part near the Rogue River, Deschutes, and Fremont National Forests. Western red cedar occurs only in the north on the Colville National Forest. Lodgepole pine, Douglas fir and white fir occur throughout, but in varying quantities. Western larch occurs from the Blue Mountains, and through the Cascade Range in Washington.

QUESTIONS (Chapter III)

1. Give the geographical and timber type divisions of the Pacific Northwest.

2. What per cent of the timber west of the Cascade range is Douglas Fir?

3. Why does the forest cover vary throughout the Douglas Fir region?

4. List the principal associates of Ponderosa pine.

5. How do these associates vary geographically?

IV. IDENTIFICATION AND USES OF THE MORE IMPORTANT PACIFIC NORTHWEST TREES.

Here in the Pacific Northwest, where the forests play such an important part in our everyday life, the well informed citizen should be able to identify at least some of our more important tree species, and know their uses. To be able to identify the various tree species of the forest also is one of the marks of a woodsman. Some people can recognize trees more or less instinctively through long association, without knowing precisely how or why. The forester, however, recognizes and differentiates between various tree species through a knowledge of certain distinguishing physical or botanical characteristics.

This scientific identification of trees is a part of the division of forestry known as dendrology. Dendrology may, in fact, be said to be the "ABC" of forestry, for through it the forester learns to read the "book of the woods". It provides the basic knowledge of the material with which the forester has to deal. Through his work in denrology the forester acquires a broad systematic knowledge of trees, including their place in the classified system of the plant world.

Trees usually are identified by the size, shape and characteristics of their fruit, foliage, bark and general structural shape. Often a tree can be identified by one of these characteristics. For instance, one can easily distinguish an apple tree by its fruit. So, too, may the Douglas fir readily be identified by its fruit, the characteristic Douglas fir cone with its three pointed bracts. In other cases it may be necessary to check on several points to be certain of the identity of the tree.

The following pages give the outstanding characteristics, range, and uses of some of our more important tree species in this region. Tree identification studies are best carried on in the forest, or with actual samples of forest tree fruit, foliage and bark. The procedure is to run the tree down through the check list, then to look it up and become familiar with its detailed characteristics as given under its name.

As a matter of information, the technical or botanical names of the various species have been given, as well as their common names. Many people wonder why these botanical names are used. The reason is that they lead to scientific accuracy. For instance, some trees have many common names, differing in various localities; but the scientific names are the same the world over, and are understood by trained foresters and botanists everywhere. This leads to precision of thought and action.

A careful study of the following pages in this section coupled with actual identification practice in the forest, should give the enrollees a ready facility in identifying our more important trees. This study opens the book of the forest in its most fascinating form, and, we hope, will lead some to a further study of this most interesting subject.

KEY TO NATIVE CONIFERS AND YEW OF THE PACIFIC NORTHWEST

Conifers

I. All leaves needle shaped; fruit a woody cone.
  A. Needles in clusters
    a. Needles 2 to 5 in a bundle; persistent; fruit maturing in two years -- PINES
      1. Needles 5 in a bundle
        (a) Needles obtuse at apex; glaucous; long-stalked cones 5" to 11"; bark broken into small squares and on young growth gray. Western White Pine (Pinus monticola)
        (b) Needles sharp pointed; dark green; long-stalked cones 11" to 20"; bark divided by large irregular furrows and deep red brown, but in young growth dully, dark gray. Sugar Pine (Pinus lambertiana)
        (c) Needles densely clustered at ends of branches; short-stalked cones 1½" to 3"; bark seldom broken, whitish scales. White Bark Pine (Pinus albicaulis)

      2. Needles 3 in a bundle
        (a) Needles deep yellow green; cones 2-¾" to 5-¾" long; bark in broad regular plates; branches not glaucous; Ponderosa Pine (Pinus ponderosa)
        (b) Needles distinctly dark blue green; cones 5½" to 11¾"; bark in large irregular plates; branchlets glaucous. Jeffrey Pine (Pinus jeffreyi)
        (c) Needles pale yellowish green; cones 3" to 6" long, lopsided, adhering to branches and trunk indefinitely, bark with shallow furrows. Knobcone Pine (Pinus Attenuata)

      3. Needles 2 in a bundle
        (a) Lodgepole Pine (Pinus contorta)
    a. Needles in tuft-like 12 to 40-leaved clusters; deciduous; Fruit maturing in one season - LARCHES
      (a) Western Larch (Larix occidentalis)

B. Needles not in clusters, but scattered singly along twigs.
  a. Needles on persistent woody pedestals leaving branchlets rough.
    1. Needles without a stalk, sharp pointed, stiff tipped and 4-sided; tip of tree upright - SPRUCES
      (a) Needles distinctly 4-sided, stomata on all 4 sides, ill-scented; young twigs minutely hairy. Engelmann Spruce (Picea engelmanii)
      (b) Needles flattened indistinctly 4-sided; stomata usually on upper side only.
        (aa) Young twigs smooth; cone scales longer than wide. Sitka Spruce (Picea sitchensis)
        (bb) Young twigs minutely hairy; cone scales as wide as long; lower branches drcop conspicuously. Weeping Spruce (Picea breweriana)

    2. Needles narrowed to a short stalk, blunt, soft and flattened; tip of tree drooping - HEMLOCKS
      (a) Needles lying flat, conspicuously grooved, rounded at apex; cones less than 1" long. Western Hemlock (Tsuga heterophylla)
      (b) Needles spreading in all directions, obscurely grooved, plump, abruptly pointed at apex; cones 1" to 3" long. Mountain hemlock (Tsuga mertensiana)
  b. Needles not on pedestals, leaving branchlets smooth.
    1. Needle-scars small, not depressed into surface of bark; cones pendulous; their scales persistent. Douglas Fir (Pseudotsuga taxifolia)
    2. Needle-scars large, depressed into surface of bark; cones erect, their scales deciduous. Balsam Firs.
      (a) Needles flattened; bracts of cone scales shorter than scales.
        (aa) Needles with stomata on upper surface
          i. Resin ducts large, up in pulp of needle; needles mostly erect; tree acutely spire-shaped. Alpine Fir (Abies lasiocarpa)
          ii. Resin ducts small, close to lower margin, needles mostly two ranked and horizontal; tree not spire-shaped. White Fir (Abies concolor)
        (bb) Needles without stomata on upper surface; resin ducts small, close to lower margin.
          i. Needles appear to grow from both sides and top of twigs - especially lustrous dark green above and silvery beneath. Silver Fir (Abies amabilis)
          ii. Needles appear to grow only from two sides of twigs - yellow green above, somewhat silvery beneath. Lowland White Fir (Abies grandis)

B (b) Needles thickened, more or less 4-sided; bracts of cone scales longer than scales. Needles with stomata on all surfaces.
(aa) Needles with groove in upper surface
Noble Fir (abies nobilis)
(bb) Needles without groove in upper surface.
Shasta RED FIR (Abies magnifica shastensis)

II. All leaves scale-like; fruit a woody cone - CYPRESSES
A. Cones and their scales oblong; branchlets flattened.
a. Cone scales 6; leaves appearing in whorls of 4 and having long bases. Incense Cedar (Libocedrus decurrens)
b. Cone scales 8 to 12; leaves obviously in pairs and having short bases. Western Red Cedar (Thuja plicata)
B. Cones globular, their scales shield or wedge-shaped;
a. Branchlets flattened (fan shaped)
1. Branchlets stout; leaves usually without glands, slightly prickly to the touch; bark thin. Fruit matures in two years. Alaska Cedar (Chamaecyparis nootkatensis)
2. Branchlets slender; leaves conspicuously glandular soft to the touch; bark thick. Fruit matures in one season. Port Orford Cedar (Chamaecyparis lawsoniana)
b. Branchlets not flattened (not fan shaped)
Macnab Cypress (Cupressus macnabiana)

III. Some leaves needle or awl-shaped, some scale-like - SEQUOIAS - JUNIPERS

A. Fruit a woody cone; leaves on side branches needlelike, lance-shaped and two-ranked, and those on main branches scale-like and often appressed. Redwood (Sequoia sempervirens)
B. Fruit berry-like
a. Leaves all awl-shaped, decidedly sharp pointed; low shrubby growth. Dwarf Juniper (Juniper communis)
b. Leaves mostly scale-like
(a) Leaves mostly in opposite pairs, not glandular Rocky Mountain Juniper (Juniperus scopulorum)
(b) Leaves mostly in whorls of threes, conspicuously glandular on back, Western Juniper (Juniperus occidentalis)

Yew

I. Single seed enclosed in fleshy scarlet berrylike covering.

A. Leaves flat, single, spirally arranged, scythe-shaped, extending down the stem. Pacific Yew (Taxus brevifolia)

WESTERN WHITE PINE
(Pinus monticola) D. Don
Also called Idaho white pine.

DESCRIPTION

Tall, slender shaft with short-branched, narrow symmetrical crown; 90 - 100 feet high; 2½-3½ feet diameter.

CONES

Long, maturing at end of second summer; tips of scales red-brown, inner portion of scales deep red; 6 - 10 inches long.

RANGE

Middle and upper slopes of northwestern mountains from west side of Continental divide in northern Montana and southern B. C., to Washington, Oregon and California.

USES

Lumber, interior finish, sash and door stock, panels, match stock, pattern work, cabinet work, woodenware, etc.

NEEDLES

5 per bundle; bluish-green with whitish tinge, 2- 4 inches long

BARK

Broken into small squares; color grayish-purple; young trees have thin, smooth, bright gray bark.

PROPERTIES

Wood, very light and soft; heartwood, pale brown; of high commercial value.

CHIEF ENEMIES

Fire, mountain pine beetle (Dendroctonus monticolae), white pine blister rust (Cronartium ribicola), and ring-scale fungus (Trametes pini)

SUGAR PINE
(Pinus Lambertiana) Douglas

DESCRIPTION

Trunk of mature trees very straight-very little taper; huge branches at right angles; 160 - 180 feet high; 4 - 7 feet diameter.

CONES

Tips of scales reddish brown, inner part deep purple-brown; 12 - 16 inches long; $2\frac{1}{2}$ - $3\frac{1}{2}$ inches diameter.

RANGE

Mountains from North Santian River, Oregon, south in Coast and Cascades, Sierras, and southern Calif. across ranges, to Mt. San Pedro Martie, Lower California.

USES

Largely for boxes in Cal., lumber, sash & door stock, furniture, fixtures, pattern stock, match stock, cabinets, interior finish, and general purposes.

NEEDLES

5 per bundle; deep blue-green with whitish tinge; $2\frac{3}{4}$ - 4 inches long.

BARK

Old bark deeply furrowed, the ridges being broken into long, irregular plates; grayish-brown in color; $1\frac{1}{2}$ - $2\frac{1}{2}$ inches thick.

PROPERTIES

Wood is light and soft, but less so than P. Monticola; heartwood, pale reddish-brown; of great commercial value.

CHIEF ENEMIES

White pine blister rust; mountain pine beetle; young trees sometimes killed by the engraver beetle (Ips confusus)

PONDEROSA PINE
(Pinus ponderosa) Laws.

DESCRIPTION

Massive; straight-trunked; long, narrow, open crown; large, bent branches; trunk smoothly cylindrical, with very little taper to branches; 125 - 140 feet high; 3 - 4 feet diameter.

CONES

Color sometimes bright grass-green and other, dark purple; ends of scales russet-brown and shiny; $2\frac{3}{4}$ - $5\frac{3}{4}$ inches long.

RANGE

From B. C. to Lower Cal., and Northern Mexico; occuring in every state west of the Great Plains and one hundredth meridian; found in Eastern Washington and Oregon in commercial stands.

USES

Practically all purposes; house construction, as for framing, siding, ceiling, panels, flooring, sash & door stock; for special factory products, pattern stock, etc. Large quantities of boxes manufactured each year for fruit shipments from Wash., Oregon and California.

NEEDLES

3 per bundle; deep yellow-green; $4\frac{3}{4}$ - $11\frac{1}{4}$ inches long.

BARK

Marked by very broad, shield-like russet-red plates, 3 - 4 inches thick. Surface made up of small, concave scales; young trees have dark red-brown or blackish, narrowly furrowed bark.

PROPERTIES

Wood, usually rather light, fine-grained, and sometimes so light and so slightly resinous as to be sold for "white pine"; high commercial value.

CHIEF ENEMIES

Western pine beetle (Dendroctonus brevicomis), and fire.

LODGEPOLE PINE
(Pinus contorta) London

DESCRIPTION

Tall, clean, slender shaft with short, rounded, small-branched crown; 20-100 feet high; 6-24 inches diameter.

CONES

Scale tips clay-brown color; inner portion bright purple-brown; 2-5 inches long.

RANGE

Up to elevation of 10,000 feet, from Yukon river southward along Cascades, Sierra Nevadas and San Jacinto mountains to lower Calif., Rocky Mts., to New Mexico. Mountain ranges of eastern Washington and Oregon.

USES

Mining timbers, poles, railroad ties, posts, farm timbers and cordwood; some box shook.

NEEDLES

Two per bundle; color from dark yellow-green to bright yellow-green; 1-3 inches long.

BARK

Deep purplish red-brown; has rough, deep furrows and ridges which are sharply cross-checked.

PROPERTIES

Wood varies in grain; fine in dense stands, moderately coarse in open; commercially important; wood quite hard.

CHIEF ENEMIES

Mountain pine beetle (Dendroctonus monticolae); fires fatal because of thin bark)

WESTERN LARCH
(Larix occidentalis) Nuttall

Also called tamarack

DESCRIPTION

Straight, tapering trunk to a height of 100-180 feet; crown narrow, short pyramid to a slender point; diameter 3-4 feet.

CONES

Scales have coating of whitish woolly hairs on outside, below their centers; 1-1½ inches long.

RANGE

High valleys and mountain slopes of southeastern B. C., northwestern Montana, northern Idaho, Washington and southward of Oregon.

USES

Structural purposes; vertical grain for flooring; finish lumber for inside; high value for exterior use due to durability; car roofing, outside flooring, doors, porches, columns, siding, steps, sash, etc.

NEEDLES

14-30 per cluster; flatly triangular and distinctly ridged; pale yellowish-green to bright lemon-yellow; 1-2 inches long.

BARK

Reddish cinnamon-brown; 3-6 inches thick, furrowed near base of tree where ridges are massive.

PROPERTIES

Wood, clear reddish brown, heavy, and fine-grained; commercially valuable; very durable in unprotected state.

CHIEF ENEMIES

Fire, fungi, and insects. Quinine fungus (Fomes laricis), ring scale fungus and velvet top fungus (Polyporus schweinitzii). Not especially subject to attacks by insects.

SITKA SPRUCE
(*Picea sitchensis*) Bongard, Carriere

DESCRIPTION

Tall, rapidly tapering stem; branches down to or near the ground; crown open narrow and sharp in upper part, but broad at bottom; 160 - 180 feet high; diameter 8 - 12 feet; butt swell at base of large trees.

CONES

Light yellow-brown; hang down conspicuously from branches; 2 - 4 inches long.

RANGE

Sea level to 3,000 feet elevation in coast region (and inland about 50 miles), from Alaska to northern California.

USES

Pulpwood, etc., lumber, aircraft material, musical instruments, boxes, ladder-stock, crates, veneer, woodenware.

NEEDLES

Prickly to touch; stand out straight all around branch; bright yellow-green; 2 - 4 inches long.

BARK

Scaly on young trees; thin on large trees ($\frac{1}{2}$ inch thick); dark purple or deep reddish-brown; has big, thin, easily detached scales.

PROPERTIES

Wood varies in color; usually pale brown, with faint, reddish tinge; light, soft; fine to rather coarse grained; large percentage of clear, straight grained wood.

CHIEF ENEMIES

Fire and wind; conk rot, or ring scale fungus.

WESTERN HEMLOCK
(Tsuga heterophylla) Rafinesque, Sargent

DESCRIPTION

Tall, clean, smooth-looking trunks, with very gradual taper; narrow, pyramidal crowns of slender branches; 125- 225 feet high; 2 - 5 feet diameter.

CONES

Hang from tips of branchlets; reddish, clay-brown when open; scales sharply narrowed from about their middle; $\frac{3}{4}$ - $1\frac{1}{4}$ inches long

RANGE

Pacific coast region from Alaska to northern Calif.; inland to southern B. C., northern Idaho, and Montana, and into the Cascades in Oregon and Washington.

USES

Pulpwood, rough and finish lumber, boxes, crates, sash & door, furniture, woodenware, caskets, barrels, etc; bark well suited for production of tannic acid for use in tanning industry.

NEEDLES

Deep, glossy, and yellow-green; covers branches thickly; grow from two sides of branches - comblike; flat with rounded end; $\frac{1}{4}$ - 7/8 inch long.

BARK

Thin finely scaley, and russet-brown to $1\frac{1}{2}$ inches thick, hard, and deeply furrowed; ridges wide, flat and irregularly connected with one another.

PROPERTIES

Wood, fine-grained, pale yellowish brown, slightest tinge of red; rather light, soft, and very unlike the slivery wood of eastern hemlock; not durable.

CHIEF ENEMIES

None serious except fire; Indian paint fungus (echinodontium tinctorum)

DOUGLAS FIR
(Pseudotsuga taxifolia) La Marck, Britton

DESCRIPTION

Trunk straight, clear of branches for 80 - 100 feet; only slight taper; crown broad, sharp pyramid; lower branches straight or drooping; 180 - 200 feet high; 3½ - 10 feet diameter.

CONES

3-pointed thick bracts protruding from among cone scales; cinnamon or reddish-brown; 1½ - 4½ inches long.

RANGE

Western Northern America from B. C. southward to central Calif., to northwestern Texas, southern New Mexico, Arizona, and northern Mexico.

USES

Lumber, structural timbers, poles, mine timbers, railway ties, car material, furniture material, boats, cooperage stock, boxes, tanks, pulpwood, fuelwood, etc., Put to more uses than any other species.

NEEDLES

Usually deep yellow-green; flat, short, slightly grooved above, and commonly blunt; ¾ - 1¼ inches long.

BARK

Dark brown on outside; clear red-brown within; 5 - 24 inches thick; very rough, with deep, wide furrows and great ridges, connected at intervals by narrower cross ridges.

PROPERTIES

Wood varies in character and grain, which may be very coarse, medium, or fine. Coarse-grain is usually reddish-brown; fine grain is clear yellowish-brown.

CHIEF ENEMIES

Fire, up to time of maturity is free from all sorts of diseases, injuries, or insect attacks; ring scale fungus, velvet top fungus, quinine fungus; Douglas fir bark beetle (Denroctonus pseudotsuga)

BALSAM FIRS - (Abies) Miller
(Genus abies) Link
Formerly called True firs

NOBLE FIR (Abies nobilis)

Commercial range limited to northern Oregon and southern Washington in Cascade range. A tall, straight tree, with small open crown in mature stage. Up to 6 feet in diameter and 215 feet in height. Bark 1¼ to 1¾ inches thick and purplish in color. Needles ½ - 1¼ inches long, occurring singly. Bark has resin blisters. Upper surface of needles is dark green, under side a silvery color. Cones 4½ to 7 inches long. Wood is heavy and strong, light brown in color. Used for lumber, siding, flooring, sash & door stock, car siding, boxes; wood pulp. Greatest enemy is fire, also Indian paint fungus.

SILVER FIR (Abies amabilis)

Best development on lower, west, and south slopes of Olympic mountains; the west slopes of Cascade range in Washington and the foothills of lower Columbia river region in Oregon and Washington. Bark becomes seamed and breaks up into conspicuous flakes. Needles 1 - 1½ inches long, fat with a groove on upper surface, bluntly pointed tip. Cones dark purple in color, 4 - 6 inches long. Wood is soft and light in weight, splits easily; not very strong. Used for boxes, interior finish, sash & door stock, and shiplap. Suitable for wood pulp. No decay until after maturity. Principal enemy is Indian paint fungus (Echinodontium tinctorum)

WHITE FIR (Abies concolor)
LOWLAND WHITE FIR (abies grandis)

Although classed as two distinct species by dendrologists, there are certain regions in which it is almost impossible to determine whether the specimen is the white fir, A. concolor, or the lowland white fir, A. grandis. This holds true in the Cascade range in southern Oregon, where the A. concolor comes northward to mix with the southern extremity of A. grandis, found in northern Oregon and Washington. General characteristics of the two species are very much the same. The name "white fir" usually is applied to either species.

Northern portions of Pacific coast and Rocky Mt. regions, in B. C., Idaho, Washington, Oregon, and northern coast region of California. Needles present flat, two-ranked appearance, twist at their base where attached to branches. Upper surface of needles white; 4 - 5 feet in diameter, up to 200 feet high. Bark of young trees is thin, grayish with brownish tinge; quite commonly with blisters. Higher altitude trees have thicker bark, 3 - 4 inches, conspicuous rough, deep furrows, long ridged. Wood, rather soft, firm, moderately coarse grained and straight. Used for light construction purposes, siding, framing, general inside use, box shooks, and wood pulp. Chief enemies are fire and Indian paint fungus on old trees.

INCENSE CEDAR
(Libocedrus decurrens) Torrey

DESCRIPTION

Rapidly tapering trunks, with widely buttressed bases; 75 -110 feet high; 30 - 50 inches diamter.

CONES

Pendulous; three pairs of scales, which upon opening, extend outward from the base; $\frac{3}{4}$ - $1\frac{1}{2}$ inches long.

RANGE

Mountains of southern Oregon, Sierras and coast range of Calif., western edge of Nevada, and northern lower California.

USES

Pencil slats, posts, poles, ties, shingles, shakes, some lumber pattern stock, chests, wardrobes, etc.

NEEDLES

Scale-like; overlap each other, only the tips free; dark green; $\frac{1}{4}$ - 3/8 inch long.

BARK

Cinnamon - brown, deeply furrowed, and ridged back; 2- 3 inches thick at base; young trees have smooth, slightly scaly, clear, cinnamon colored bark.

PROPERTIES

Wood, fine and very straight grained, pale or dull yellow-brown, sometimes tinged with red; soft, light, and very durable.

CHIEF ENEMIES

Dry rot fungus (Polyporus amarus) and ground fires.

WESTERN RED CEDAR
(*Thuja plicata*) D. Don

DESCRIPTION

Decidedly conical trunk form. Old trees "swell-butted"; conspicuously infolded or fluted at base and for 10 - 20 feet above it; 150 - 175 feet high; 3½ - 12 feet diameter.

CONES

Very small; leathery brown; double winged seeds; usually about ½ inch long.

RANGE

Southeastern coast of Alaska and south to northern Cal.; east through southeastern B. C., through northern Washington to northern Idaho and Montana, and to the Cascades of Washington, and Oregon.

USES

Poles, shingles, lumber, caskets.

NEEDLES

Scale-like; dark green; overlapped.

BARK

Very thin; peels off easily in long narrow strips; clear, reddish, cinnamon-brown; ½ - ¾ inch thick

PROPERTIES

Wood, very light, strongly aromatic; dull, slightly reddish brown; grain from medium coarse to fine; rather brittle and soft.

CHIEF ENEMIES

Fire most important; no insects or fungi to speak of.

PORT ORFORD CEDAR
(Chamaecyparis lawsoniana) A. Murray, Parlatore

DESCRIPTION

Base usually buttressed and irregular in form; 125 - 180 feet high; 3½ - 6 feet diameter

CONES

Round; dark russet brown when ripe; ¼ - 3/8 inch long.

RANGE

Coos and Curry counties in Oregon, not over 40 miles from coast; narrow belt south of Klamath river in Cal., southern slopes of Mt. Shasta and up Rogue river towards Grants Pass.

USES

Lumber, battery separators, general interior finish, boat construction, pattern stock, sash & door stock, tunnel work, ties, furniture, chests, drawers, etc.

NEEDLES

Scale-like, small, on flat sprays, soft to the touch; points short and blunt.

BARK

Silvery brown, ridged and broken; thick at base, 6 - 8 inches at times; deep, narrow seams, loose ridges which separate into long strips.

PROPERTIES

Wood, light weight, very fine grained, yellowish-white color, faint aromatic odor; hard and firm; very durable.

CHIEF ENEMIES

Fire is only one. Wood is resistant to both decay and insects.

REDWOOD
(Sequoia sempervirens) Lambert, Endlicher

DESCRIPTION

Buttressed bases; trunks not in open are clear of branches to 100 feet; 190 - 280 feet high; 8 - 12 feet diameter.

CONES

On slender branches; scales thick and close-packed. $\frac{3}{4}$ - 1 inch long.

RANGE

Northern California and extreme southwestern Oregon; up to 2500 feet elevation.

USES

Lumber, novelties, flumes, shingles, wine-vats, furniture, caskets, tobacco boxes.

NEEDLES

Sharp pointed, stiff; from 2 - rank position to scale-like pressing to the branch; bright yellow-green; 1/3 - 1 inch long.

BARK

Widely furrowed, with rounded ridges; fibrous, 8 - 10 inches thick at base, dark, cinnamon-brown, tinged with gray.

PROPERTIES

Soft wood, light weight, coarse to fine, straight-grained, brittle, durable.

CHIEF ENEMIES

Fire resistance of old trees good; young trees may resist fire but lengthwise seams open in trunk, providing admission for fungi; trees not attacked by insects.

WESTERN JUNIPER
(Juniperus occidentalis) Hooker

DESCRIPTION

Short, thick, conical trunk; round-topped, open crown; 15 - 30 feet high; 16 - 30 inches diameter.

CONES

Bluish black, covered with whitish bloom; "berries" 1/4 - 1/3 inch long.

RANGE

Generally throughout Wash., Oregon, to southern Cal., arid hills and high plains; southern interior of B. C.

USES

Chests, posts, pencil slat material.

NEEDLES

Scale-like; ashy-green; clasp stiff twigs closely; marked on back by a glandular pit; 6 rows of leaves around twigs.

BARK

Clear, light cinnamon-brown, $\frac{1}{2}$ - $1\frac{1}{4}$ inches thick; wide, shallow furrows.

PROPERTIES

Wood pale brown, tinged with red; fine grained; slight aromatic odor; very durable; soft and brittle.

CHIEF ENEMIES

Quite resistant to decay and insects; fire is only menace.

YEW

PACIFIC YEW
(Taxus brevifolia) Nuttall.

DESCRIPTION

Trunks are straight and conical; branches stand out straight; 20 - 30 feet high; 6 - 12 inches diameter.

CONES

Bright coral-red fruit, ripe in Sept.; begins to fall during October; seed leaves, 2; flat, short and pointed.

RANGE

Pacific coast region south from Alaska and east to Selkirk Mts. ; western Oregon & Wash. to Calif; mountains of eastern Wash., Oregon, and Montana.

USES

Canoe paddles, bows, small cabinet work, and some posts.

NEEDLES

Deep yellow-green; soft to touch; paler on under sides than above; stalk-like construction.

BARK

Very thin, rarely over $\frac{1}{4}$ inch thick; papery, purple, easily detached scales.

PROPERTIES

Wood, fine-grained, clear rose-red; dense, rather heavy and remarkably durable.

CHIEF ENEMIES

Fire, due to thin bark; quite resistant to insects and fungus attacks.

BROADLEAVES

BLACK COTTONWOOD
(Populus trichocarpa) Hooker.

DESCRIPTION

Large size, 2 - 3 feet diameter; bark 1½ - 2½ inches thick, ashy gray and deeply divided into broadly rounded ridges.

LEAVES

Dark, shiny green on upper side and pale or silvery white underneath; heart-shaped with acute point, finely toothed edges.

RANGE

Lower elevations; moist sites west of Cascade range in southern B. C. Washington and Oregon

PROPERTIES

Wood is light weight, dull brown in color with narrow band of nearly white sapwood; not durable, and of little strength; soft, even texture.

USES

Pulp wood, excelsior, cooperage stock, core stock for veneers, etc.

CHIEF ENEMIES

None of importance, outside of fire.

RED ALDER
(Alnus rubra) Bongard

DESCRIPTION

Relatively small size, 120-130 feet high, rarely over 30 inches in diameter; trunk straight and slender; bark ash gray or white, spotted by characteristic dark blotches, thin, about $\frac{1}{8}$ inch thick.

LEAVES

Smooth and deep yellow-green above, paler beneath and covered with very short hairs; 3 - $5\frac{1}{2}$ inches long; toothed borders are slightly curled toward under surface; cones $\frac{1}{2}$ - 1 inch long; scales very thick and blunt - squarish.

RANGE

From southeastern Alaska to southern California, but commercial range limited to moister lowlands of western Oregon and Washington, and southwestern B. C.

PROPERTIES

Grain of wood straight and uniform texture; will not warp, check, shrink, nor swell when handled properly; moderately light in weight; soft in texture.

USES

Furniture manufacture, woodenware, veneer, core stock, handles, etc., adapted to pulp manufacture.

CHIEF ENEMIES

None of importance outside of fire.

OREGON WHITE OAK
(Quercus garryana) Douglas

DESCRIPTION

Average size 50 - 60 feet high; 20 - 30 inches diameter; only oak in Pacific Northwest.

LEAVES

Quite deeply lobed, $3\frac{1}{2}$ - $6\frac{1}{2}$ inches long, somewhat leathery; deep shiny green and hairy underneath. Fruit is an acorn, rather sweet.

RANGE

Washington, Oregon and northern California, and to a slight extent on Vancouver Island in B. C.

PROPERTIES

Wood, heavy, moderately strong, very hard; older trees inclined to be flinty and brash.

USES

Some general lumber uses, handles, cooperage, chairs, plywood, and general millwork.

CHIEF ENEMIES

Mistletoe and fire.

BIGLEAF MAPLE
(Acer macrophyllum) Pursh.

DESCRIPTION

Tree suitable for lumber, only in dense stands; fairly straight hole clear of limbs for 40 or 50 feet; up to 100 feet high; up to 30 inches diameter.

LEAVES

Deeply lobed, 7 - 10 inches side, stems 6 - 12 inches long; seed composed of a pair of one-winged seeds joined together.

RANGE

From southeastern Alaska to southern California; commercial range confined to stream bottoms and lowlands in western Washington and Oregon.

PROPERTIES

Wood, light pinkish to light brown in color; straight grain, usually fine, rather hard, firm.

USES

Furniture manufacture, woodenware, general millwork, brush and broom handles, fixtures, etc.

CHIEF ENEMIES

None of importance.

BRIEF GLOSSARY OF TECHNICAL TERMS

Acute - Pointed
Angiospermae - Plants with seeds enclosed in an ovary. Includes all broad-leaved species.
Apex - The top
Articulate - Jointed or having the appearance of a joint
Bud - The undeveloped state of a branch or flower - cluster with or without scales
Deciduous - Falling, said of leaves falling in the autumn
Dorsal - Relating to the back
Embryo - The rudimentary plant formed in the seed.
Glabrous - Smooth
Glandular - Furnished with glands
Gymnospermae - Plants with naked seeds. Includes all coniferous woods, except yew.
Imbricate - Overlapping
Lanceolate - Shaped like a lance
Linear - Said of a narrow leaf several times narrower than long, with parallel margins
Midrib - The central or main rib of a leaf
Naked buds - Buds without scales
Obtuse - Blunt or rounded at the apex
Ovule - The part of the flower which becomes a seed
Persistent - Said of leaves remaining on the branches over the first winter.
Pistil - The female organ of a flower, consisting of ovary style and stigma
Petiole - The footstalk of a leaf
Pubescent - Clothed with soft short hairs
Seed - The fertilized and mature ovule, the result of sexual reproduction in a flowering plant
Stamen - One of the male organs of a flower
Stigma - The part or surface of a pistil which receives the pollen for the fecundation of the ovules.
Stomata - Breathing pores on the surface of leaves
Style - The attenuated portion of a pistil between the ovary and the stigma

QUESTIONS (Chapter IV)

1. Give complete descriptions with the principal enemies and uses of the forest trees in your locality.

2. What timber species would you recommend for structural timbers?

3. What would be the deciding factor, from an economical standpoint, in the manufacture of box shook between Sugar pine and Western white pine?

4. A farmer just east of the Cascade range desires some timber for fence posts. What species would you recommend? Why?

5. What is the greatest use of spruce and hemlock in the Pacific Northwest? Why?

6. What species is put to the most uses in the Pacific Northwest?

7. Describe briefly, by name, the balsam firs and their locations.

8. What is the most important commercial use of the following species:

   a. Incense cedar
   b. Port Orford cedar
   c. Western red cedar
   d. Redwood
   e. Pacific yew
   f. Red alder
   g. Oregon white oak
   h. Maple

9. Define the following terms:

   a. Deciduous
   b. Gymnospermae
   c. Ovule
   d. Persistent
   e. pistil
   f. Pubescent
   g. Stamen
   h. Stomata

V. SUSTAINED YIELD AND SELECTIVE LOGGING

The terms "sustained yield" and "selective logging" have been prominent in the press and in popular discussions of forest matters recently. Often these terms have been used loosely, without a proper background as to what they actually mean. This leads to confusion of thought. It is important that the meaning of these terms be understood. It will not be possible here to give the complete background. It is hoped that enough can be given to lead to more accurate thinking and talking on this subject.

1. What is Sustained Yield?

Briefly, sustained yield means a system of forest management for a given tract of forest, by means of which the land shall continue to produce as much in the way of forest products as is removed. It seeks to provide a reasonably fair balance between the average cut, or "harvest" from a forest area, and its average producing capacity. This results in stabilizing wood-using industries in the region dependent on the forest for raw material. A permanent supply of raw material is the foundation of industry, and the regular harvest of mature forest products is the object of good forestry.

2. "What is Selective Logging?"

This term means different things to different people, according to their interests, knowledge, and background. The logger or timberland owner usually approaches it from the economic angle, seeking an answer to the question: "How can I log this forest to secure the largest financial return?" The forester, on the other hand, approaches it from the larger social angle of the good of the forest, and its permanent producting power. Present-day thinking seeks to find a common meeting ground for these two viewpoints.

In a report on Forest Terminology issued by a committee of the Society of American Foresters in 1916, the "selection method" was defined as meaning "that method of cutting in which single trees, usually the largest, or small groups of such trees, are removed and reproduction secured under the remaining stand and in the openings".

3. Selective Logging in Pine.

This is the method commonly used in European forestry. It is the system in general use on the national forests of the ponderosa pine region of Eastern Oregon and Washington. Here the forest usually is found to be a mixture of trees of various ages. In one stand there will be fully mature and over-ripe trees; half-grown trees which are

naturing rapidly; young trees; and baby seedlings. The trees, as a rule, are wind-firm. Isolated trees may be left without undue danger of blowing over. The practice is to mark individual nature trees for cutting, leaving a sufficient number of seed trees and young growing stock of various ages, to insure future cuttings. The trees must be taken out with proper regard to that which is left, so as not to damage the reserve and seed supply. Horse or tractor logging is the preferred method. The slash must be disposed of in such a way as to remove the fire hazard, but not to damage the young growth. The usual method has been to pile and burn the slash at proper times; some variations of this method are being worked out, to meet special conditions.

4. For the Douglas Fir Region.

In the Douglas fir region west of the Cascade Range, different conditions are found, and different methods of operation employed. Also, within the Douglas fir region, conditions vary. Blanket rules cannot apply arbitrarily. Often the system for a given logging show must be worked out on the ground by a qualified expert. He must base his conclusions upon the scientific, economic and social conditions as they exist.

The tree selection method, as applied to the pine forests, may be used occasionally in Douglas fir logging, where conditions are right. As a rule, however, the valuable trees in this type are of the same age, with sometimes an understory of hemlock or other less valuable species, as a consequence of which clear cutting has prevailed. Under this syten, natural regeneration requires the seeding facilities of scattered trees or groups and blocks of trees so spaced that a supply of seed sufficient to adequately restock the ground will result. At the present time, a great deal of attention is being given to "Economic Selective Logging", in which the more valuable timber is removed in small blocks, leaving the areas of low value as a reserve stand and seed supply, and incidentally simplify slash disposal and fire protection.

It is a fundamental of this system, properly applied, that no part of the clear-cut area should be more than a quarter of a mile from a block of seed trees. Scattered trees may be used as a supplemental provision.

The early-day loggers in the Douglas fir region unconsciously logged in a manner which resembled this method. They took the most accessible and most profitable trees and left the rest which was, in many cases sufficient to supply seed and to furnish a second cut. This was done for financial, rather than for forestry reasons, but the results were beneficial, both to the industry and to the forest.

With the advent of modern power machinery and high-speed logging, vast areas were clear cut, burned and reburned, and prompt reforestation did not follow. Incidentally, under modern logging methods, the industry has been taking a great deal of unprofitable material out of the woods. Good business management, as well as forestry, suggests a trend toward the selection system of logging, wherever practicable.

In any form of cutting under sustained yield management protection of the cut-over area from fire is essential. Therefore, all snags must be felled, and such disposal of the slash made as is indicated by conditions on the ground. Usually, in a fir operation, this is accomplished by broadcast burning the first year after logging, taking precautions to prevent damage to the blocks of seed trees and the reserve stand. Then every effort is made to keep recurring fires out of the area.

When discussing reforestation, we often hear the remark: "Oh, but it takes from 60 to 200 years for a tree to reach sawlog size. That's too long to wait". The forester does not look at it this way. Rather, he considers that each growing tree is producing a definite amount of wood each year. This annual growth can be calculated. Likewise, the annual growth on an entire watershed or "working circle" can be calculated. That is the annual crop. Obviously, it would be silly to attempt to harvest the annual growth from each tree. But, by setting up the annual growth on the working circle as an annual cutting budget, and cutting that much each year, block by block, the same result is attained. Then, if the land has been left in proper condition to reforest, and fire has been kept out, the process can be repeated, indefinitely. That is sustained yield management. That this is entirely possible, has been proved on many national forest timber sales, and in European forests. One forest property in Sweden recently celebrated its 700th anniversary of logging!

To obtain these results the cutting system must provide for prompt regeneration, according to the character of the forest type and the habits of the several species which it contains. Since natural regeneration generally is the cheapest and most satisfactory, selection forms of cutting are favored wherever practicable of application. Trees are left for seed, the young age classes retained to mature and provide succeeding cuts.

5. What is Reforestation?

To the forester "reforestation" has a definite and specific meaning. As a technical word, it means the restoring of an area to forest, either by artificial or natural means. That is, either the growing and setting out of young trees or by direct seeding on

land which once had forests, or the gradual restocking with forest (by nature) of land once forested. That is the correct or technical meaning. Likewise, afforestation means the planting of a forest on land which has not previously borne forest. Deforestation means the destruction or removal of forest from land with no conscious effort to restock the land.

Of late, however, the word "reforestation" has come to be used popularly to cover a much wider field. In this popular sense, it has come to mean almost any method, means, or system whereby forest land is improved, developed or protected, whether the land is cut over or is now bearing mature timber. This broad meaning is the one used in the act of Congress which provided for the establishment of the Civilian Conservation Corps.

No doubt all of the men connected with forestry work in the North Pacific Region have frequently been asked "what is being done in the way of reforestation", or "Why doesn't the government do more reforestation work"? Their answers, based on the technical meaning of the word, usually are that here, in this region, natural regeneration can best be depended on, provided fires are kept out or controlled. It is necessary to plant only where repeated fires have destroyed all the available seed trees and have reduced the productivity of the ground to such an extent that seeds will not germinate and live. Some 25,000 acres of land have been planted to forest trees by the Forest Service in Oregon and Washington. This work will be continued where necessary, but the main job is to protect and develop the forest resources of this region and let nature take care of the actual job of providing for a new crop of trees to replace those cut or destroyed. There are numerous places in all timber types which can be pointed out as illustrating this point.

QUESTIONS (Chapter V)

1. What is sustained yield and how does it affect the wood-using industries?
2. In what region is "selective logging" now practiced in the Pacific Northwest? Why?
3. Give a brief account of selective logging methods as practiced in the Pacific Northwest.
4. Does this method of logging vary any in the region as a whole? Why?
5. Explain the difference between "selective Logging" and "Economic Selective Logging".
6. What is most essential in a program of sustained yield management?
7. Define a "working circle" and explain how it fits into the plan of sustained yield.
8. How would you define "reforestation" to apply to the Pacific Northwest?

VI. THE IMPORTANCE OF FOREST FIRE PREVENTION

In his address to the Congress asking for the creation of the Civilian Conservation Corps, President Roosevelt said, in part, as follows: "This enterprise is an established part of our national policy. It will conserve our precious natural resources. It will pay dividends to the present and future generations. It will make improvements in National and State domains which have been largely forgotten in the past few years."

In other words, conservation is an important objective of the Civilian Conservation Corps. Here in the Pacific Northwest particularly, the most important single phase of conservation is the protection of our forest resources against destruction by fire. That is why the CCC camps in this Region, during the past two years, have been engaged largely in the construction of forest protection improvements, and in hazard reduction.

That is why, also, that every man in the Corps should be thoroughly instructed in forest fire prevention, and should do everything in his power to prevent fires from being started. An old adage says "An ounce of prevention is worth a pound of cure". Keeping well is better than getting sick. Fighting forest fires is expensive, and valuable resources are lost while the fire is being controlled. Preventing forest fires saves time, money, and valuable national resources.

Every man in the Civilian Conservation Corps should thoroughly understand the prevention of forest fires. It is part of the creed of the woodsman. Carelessness with fire in the woods is the surest mark of the tenderfoot.

1. Objectives in Forest Fire Prevention

The following objectives for the North Pacific Region of the Forest Service are quoted from the Region Six Fire Control Handbook;

A. To reduce to the minimum the annual number of man-caused fires. This objective is to be obtained through:

(a) Local public relations effort
(b) General educational work.
(c) Restrictions on travel and the use of fire, under State laws and Federal regulations.
(d) Adequate precautions in industrial operations and construction work.
(e) Law enforcement.

B. To minimize the danger of fires starting or spreading because of an excessive amount of inflammable debris. This objective involves:

(a) Securing adequate slash disposal on timber sales and special use or other projects in national forest lands.

(b) Securing adequate slash disposal on private lands.

(c) Roadside clean-up.

(d) Clean-up along trails, lakes, and streams where the amount of debris and public use warrants.

(e) Construction of firebreaks and clean-up of debris in old burns.

(f) Construction of fire lines and disposal of debris in lodgepole deadenings, blowdown areas and old cut-over areas.

Results under (c) to (f) will depend very largely upon special funds available for these purposes, although a great deal can be accomplished with contributed time.

2. Reduction of Man-Caused Fires

The Problem. Normally about 61 per cent of the fires in Region 6 are man-caused. This percentage is too high; it must be reduced if costs and losses are to be brought to an acceptable minimum. The record for the first four years of the present decade shows an even higher percentage. It is essential that all forest officers concentrate on the problem in their respective localities and constantly strive to develop a fire consciousness in the public mind which will result in care with fire and observance of the fire laws.

Campers and smokers are responsible for by far the largest number of man-caused fires. During the four years 1931-34 they caused nearly one-half the total number and 31 per cent of the costs and damage. Campers' fires, while numerous, are much less destructive than smokers' fires. Smokers were responsible for 29 per cent of the cost and damage during the above period. The problem of reducing losses due to carelessness with burning tobacco and matches is a challenge to every forest officer.

Incendiarists have been responsible for heavy losses in the past. They caused 14 per cent of the fires from 1931 to 1934 and 23 per cent of the cost and damage. In general, incendiarism fluctuates with the employment situation, but there are certain definite areas where it is chronic. While education and the development of a public fire consciousness will have their effect in reducing incendiarism, the most effective weapons to use against it are vigilance and removal of the job incentive.

Lumbering fires are not numerous, but they are difficult to handle because they start in particularly hazardous areas. They caused 19 per cent of the cost and damage during the four years 1931-34, and this percentage would probably have been higher but for the depression in the lumber industry. Debris burning, also, causes material losses every year. Fire losses in connection with these essential activities can be reduced by education of and cooperation with land owners and operators and by insistence on compliance with the law.

3. Educational Effort

Forest officers are required to plan carefully to meet their problems of the man-caused forest fire. Fire prevention education, to be most effective, is based on sound analysis and planning. A careful analysis of the man-caused fire increase is made for each ranger district to determine specific causes, classes of people responsible, sources of people responsible, motives or reasons such as carelessness, ignorance, indifference, maliciousness or personal profit, and what type of appeal will reach each class of individual based upon this analysis.

Each forest officer makes a definite local fire prevention plan. Such a plan deals with individuals, local organizations and communities, and the method to be followed in meeting each problem. In addition to this local planning, general educational work is used to present to the public the importance of forest fire prevention.

The press is considered the most valuable medium for reaching large numbers of people. Detailed technique in this field is discussed in the Region 6 booklet "Forest News Reporting". Fire prevention talks, radio broadcasts, exhibits, and other similar methods are used to develop a forest fire prevention consciousness on the part of the public.

4. The Mark of the Woodsman

The proper use of fire in the woods is one of the outstanding indications that a man has become a seasoned woodsman. Since most man-caused forest fires come from the thoughtless use of smoking materials or camp fires, the woodsman will give particular attention to these things. Here are six rules for preventing fire

in the forest, which should be memorized and constantly followed:

(1). Matches. Be sure your match is out. Break it in two before you throw it away.

(2). Tobacco. Be sure that pipe ashes and cigar or cigarette stubs are dead before throwing them away. Never throw them into brush, leaves, or needles. Follow the Smoker's Code.

(3). Making Camp. Before building a fire, scrape away all inflammable material from a spot 5 feet in diameter. Dig a hole in the center, and in it build your camp fire. Keep your fire small. Never build it against trees or logs, or near brush.

(4). Breaking Camp. Never break camp until your fire is out - dead out.

(5). Brush Burning. Never burn slash or brush in windy weather or while there is the slightest danger that the fire will get away.

(6). How to Put Out a Camp Fire. Stir the coals while soaking them with water. Turn small sticks and drench both sides. Wet the ground around the fire. Drown it completely, then pour on more water. Drown that last spark.

5. What About Light Burning?

"Light Burning" is the name of a plausible method which is sometimes advanced as the proper way to prevent damage from forest fires. As preached and practiced, it means setting fires in the woods in the spring or fall in order to burn over the territory to be protected. The claim is made by these light-burning advocates that when this is done properly the dead needles, branches, and litter are consumed with no damage to merchantable timber; the chance of serious fires during the hot season is eliminated; bark beetles and other insect pests are destroyed; the troublesome understory of "brush" is removed and grazing is improved.

Forest protection is condemned as a failure; becoming, they say, more impracticable year by year; doomed to reach a point where it will be wholly impossible, and conflagrations will sweep the country.

There is a great deal of nonsense, a mass of misinformation, and a trace or so of truth in the belief expressed above. Fire has unquestioned uses in removing some kinds of hazards; for example, long experience has shown that slash left after logging must be burned or special measures taken to protect it, and the State law provides for this. Piles of brush along roads, trails and railroad

rights-of-way make fire wardens uneasy until they are disposed of. The ordinary and accepted way to get rid of any particularly dangerous fire hazard is to burn it at the right time, which means at a time when the fire can surely be held after it has done its work. But this use of fire by no means includes general light burning of forest lands.

Any fire in the woods is likely to do some damage. In the cases just mentioned, where the hazard to be removed is great and is limited to some particular spot, the damage may be trifling, and heavily outweighed by increased safety to the surrounding woods. This is not true of fires covering large areas of forest land.

During the ten years 1920 to 1929, the loss of merchantable timber from all the forest fires in the Douglas fir regions was 0.0036 - thirty six hundredths of one per cent.- of the total stand. This is almost exactly the insurance rate on so-called fire proof office buildings and the best class of residences. As far as grown timber is concerned, protection makes it one of the best of all fire insurance risks.

A. Damage to Mature Timber. In ponderosa pine forests, repeated studies of loss from light ground fires show that the loss from each of them amounts to from 2 to 5 per cent of the merchantable timber. Old fire scars, known as "catfaces" will burn when there is snow on the ground, or in any kind of weather. After a number of fires, the tree is burned through and falls or is wind-thrown. New catfaces are commonly started by fires which smoulder in the accumulation of bark around the base of a tree, or by the heat from a burning branch or log. The inner bark is cooked; the outer bark dries, pitch accumulates, and the next fire starts the cavity. If the tree is logged before enough fires come along to kill it, there is still a loss of high-grade lumber from the accumulation of pitch or the various kinds of rot that may enter through a fire scar. The average scale deduction from fire-scarred butt logs is about 15 per cent.

Our forest lands are producing only a part of what they should, because of fires during the past centuries. This is particularly true of the ponderosa pine lands. An acre of even-aged pine 100 years old ought to contain upward of 30,000 feet of saw timber. The quality of our land and the growth habit of the tree should insure this. Half that amount of mature timber is a good stand in our fire-scourged woods. The other 10 or 15,000 feet that should be there have been lost, a little at a time, largely through recurring ground fires similar to those advocated by light-burners.

B. How About Bugs? Light burning does not destroy the pine bark beetles - IT ATTRACTS THEM. The Bureau of Entomology makes this unqualified statement after years of observation of the ponderosa and sugar pine forests in Oregon. A number of fires are cited, upon which the insect damage in 3 or 4 years following the burn was from 4 to 12 times that in the surrounding timber. There are instances of normal infestations changing to epidemics following and on account of forest fires. The losses became so heavy that costly control work was demanded. The severity of the fires had nothing to do with the amount of timber which the bugs killed. The light fires attracted the bugs as well as the heavier fires.

C. Damage to Young Tree Growth. The claim that repeated fires remove the brush depends upon what is meant by "brush". If it includes young pines, firs, and other conifers, the answer is emphatically "yes" , but without the small trees the future forests are of course impossible. During the first 20 years, these saplings have thin bark; their crowns are close to the ground, and almost any fire will kill them. Once killed, they stay dead, because none of the conifers outside the redwood belt, and one or two in the Atlantic slope, sprout from the root. Practically all the hardwoods and brush do. Snowbrush, manzanita, and all the rest of them come back immediately after a fire with a strong, persistent growth and a larger number of shoots. Only a few of them, however, will grow in the shade. The ground beneath a well-stocked mature stand of timber is usually fairly clean. It is the brush and partly-burned woods that become brush jungles. The way to get rid of brush is to let the valuable forest trees shade it out.

D. Burning for Forage. The burning of forest lands sometimes gives the stockman a temporary advantage. If the intention is to change forest land to grazing land; to kill the pine and get rid of it, burning is in some ways a success. There are probably areas which on account of their locations and quality will be permanently more profitable as pasture than as forest, or mixed forest and pasture. There are probably areas which will respond to this sort of treatment, and after sufficient burning, will settle down as pasture. But indiscriminate burning does not insure this. Some forest lands produce little or no forage when the shade is removed; some revert to brush when exposed to full sunlight; on some soils, fires take out the grass roots, and no forage remains. Burning may be expected to intensify bad conditions caused by over-grazing or other abuse of range land. Light burning is by no means a general remedy for the stockman's troubles. It is a risky measure which succeeds once in a while, when expertly administered, but is equally likely to bring the wrong result. And whatever its advantage to grazing, its effect on tree growth is unfavorable.

Most timber owners, including the Federal Government, consider the possible benefits to grazing too slight and too uncertain to make up for the known harm to the forest which almost invariably follows.

E. Theoretical, but not Practical. Actual experiments carried on to develop a method of getting the possible benefits of light burning without killing the timber which was to be protected and benefited, have brought out the fact that as a general protection measure, it is not practicable. Forest land is not level. It is made up of hills and valleys. Fires that burned tamely on the flats blazed fiercely on the hillside; on cool, moist north slopes a blaze could be kept going only with difficulty, while on a south or west slope, it would be hot enough to kill, like any other forest fire. Burning for a while in the forenoon might be, in a way, a success; in the afternoon it would be out of control; in the evening the fires were not strong enough to get the results that were intended. Suitable burning days are not frequent. The times when a fire will do its work and then go out are too rare to be dependable.

F. A Question of Cost. Of course, it is possible to burn without doing any appreciable damage. It has been done repeatedly on small tracts. The method is to rake or roll the litter away from the trees, cover the catfaces with earth, and cut any brush which might flame up and kindle or kill the crowns. It works well in all respects but one. It costs too much. By the time the job is done, from 35 cents to a dollar an acre has been spent. On the other hand, adequate protection can be secured for only 3 cents to 4 cents under present protection methods.

To give effective protection, light burning must be kept up. According to the light-burning proponents, it must be repeated every two or three years.

All protective agencies - federal, state, and private - just as much as timber owners, are all interested in and anxious to find cheaper and better ways of preventing damage to timber stands. They have studied this matter and have gone at some length into the possibilities of getting better protection through light burning, but they are convinced, for the reasons as stated briefly above, that LIGHT BURNING WILL NOT GIVE PROTECTION!

On the basis of this analysis it is considered that any man advocating or encouraging the light-burning theory is unsuited for a position in the Forest Service.

QUESTIONS (Chapter VI)

1. Why is forest fire prevention stressed so heavily in the Civilian Conservation Corps camps of the Pacific Northwest?

2. What is the largest single problem with which we must struggle to reduce the number of fires in our region?

3. Of all the fires started what type is the most hazardous? Why?

4. What methods are at present employed to educate the public toward forest conservation?

5. Recite from memory the six rules for preventing fire in the forest.

6. Why do we not advocate light burning? Describe briefly the effects of light burning on a forested area.

VII. FOREST IMPROVEMENTS AND WORK PROJECTS.

1. Relationship of Forest Improvements to Fire Control.

A careful analysis of each work project of the Civilian Conservation Corps will show that in nearly every case the reason for the project can be traced back to one fundamental factor - forest protection. This explains, also why so much stress is placed on organization for fire fighting, training in fire-fighting methods and the importance of observing the rules for fire prevention. There are a number of cases where other factors than protection are of paramount importance, such as roads which are definitely a recreation development, ranger station improvements, etc., but even here the improvement work will definitely speed up and make more efficient the fire protection work.

Campground development might be taken as an example. A certain area needs more camping places to take care of the people who visit the forests. These camps are built; tables and fireplaces are provided; latrines and garbage pits constructed; water is piped to the area; unsightly and dangerous fire hazards are removed. With those things done the public will use the forest camps rather than stop at some place along the road where no conveniences are provided. The campground is fairly fire-proof. Every effort has been made to make it as much so as possible. The water that has been piped there and made easily available for domestic use also will be readily available for extinguishing the campfire. In other words, the development of this campground has been a fire prevention measure as well as a recreation one.

Roads and trails, while they provide easier access to the forest-using public, primarily are constructed because they provide quicker transportation to the area in case of fire. Telephone lines are the means of communication from the detection system to the ranger or dispatcher and from him to the first lines of defense — the smokechasers or guards. During fire season their use for any other purpose is strictly limited and discouraged.

Drift fences and range water developments also are protection measures — they give a greater opportunity for regulating the use of the range to prevent overgrazing and to secure the maximum use. Insect control and blister rust control projects are forest protection measures almost as important as fire control. Erosion control projects assure protection against the loss of soil which, though not now bearing forests, is primarily valuable for forest growth.

Consider each one of the projects of your camp and you will find that it is related to some form of forest protection.

2. The CCC and Project Planning.

One of the most common misconceptions of the ECW camps concerns the usefulness of the work being done. Some people have stated that as a means of giving employment and as a man-building proposition the Corps serves a useful purpose, but as for the value of the work being done it is a failure.

Much can be done by the overhead in the camps to correct this wrong impression. The main reason for this belief is that, since the ECW was organized so hurriedly, and since the number of men in the woods was so greatly increased over previous years, it is thought that the work must be "made work" - thought up on the spur of the moment just to keep the Corps busy "doing something".

A consideration of the facts shows this to be entirely erroneous. Work projects are never undertaken haphazardly by the Forest Service. Each job is a part of a carefully conceived plan of necessary improvement work. Plans are made for years in advance and are made as the result of studies to determine what must be done within that period to provide the best possible protection and development of forest resources.

The individual projects upon which the ECW camps have been working are a part of that "ten year plan". Just as in the original plan of attack, each job has had a priority rating. Some jobs were more important than others and were, therefore, undertaken first. The others will take their turns - and if the Corps is continued long enough, all these plans will become a reality. It is important to remember, however, that each of these jobs is not just something that the ranger would like to have done. Each is a necessary part of the improvement work that must be done if we are to protect and preserve the resources of the forests which are entrusted to our care.

QUESTIONS (Chapter VII)

1. How does the development of a campground influence forest protection?

2. What are the primary and secondary functions of forest roads and trails?

3. What is the "ten-year" plan and how does the CCC fit into it?

VIII. THE FORESTRY ORGANIZATIONS IN THE PACIFIC NORTHWEST

There are three major agencies directly concerned with the handling and protection of the forests and forest crops in Oregon and Washington. These are the Federal Government, the State government, and the private timber owners. In some regions of the United States a fourth factor is introduced by the county or municipal forest. Back of these directly active forest agencies, stands another factor, silent but powerful, - the public. Public thought and action make possible the constructive work of the forestry agencies; and public carelessness or apathy can undo or defeat the best forest policy ever framed.

The three forestry agencies mentioned above are closely related in their reactions upon the forest resource. This has brought about a cooperation between these agencies, which constantly is being improved and made more effective. The passage by the National Congress, on June 7, 1924, of the Federal Reforestation Act (Clarke-McNary), was one of the most important forward steps along the lines of cooperation that has been taken in the history of American forestry. Before proceeding to a consideration of the three forestry agencies, a brief mention of some of the main points of the Clark-McNary Act is in order.

1. The Federal Reforestation Act (Clarke-McNary)

This act is a recognition that the Federal Government, the States, and the private timber owner each has an interest and a responsibility, not only in the protection, but the perpetuation of the forests of the Nation, and that each should bear its share of the responsibility and cost.

Besides defining a national forestry policy, important features of the act provide for: (a) cooperation in protection from forest fire by Government, State, and private owner of timbered and forest-producing lands; (b) a Nation-wide study of forest taxation; (c) forest planting on a cooperative basis between the Government and States; and (d) the enlargement of public ownership (by Federal, State, and municipal agencies) of forest land through gift, purchase, exchange, or reservation of the public domain.

2. The U. S. Forest Service.

The Forest Service is a bureau of the Department of Agriculture. It administers the national forests and seeks to promote the best use of all forests and forest products of the United States through research, cooperation with states and with private agencies, and the diffusion of useful information on forestry. In 1876 a forestry agency

was set up under the Commissioner of Agriculture. By 1881 this agency had developed into a Division of Forestry, which, in 1886, received statutory recognition (Act of June 30, 1886). It became the Bureau of Forestry in 1901.

Since July 1, 1905, this bureau has been known as the Forest Service, but the change in designation effected no change in formal status.

Working directly under the Secretary of Agriculture is the Chief Forester of the United States. His office, located in Washington, D. C., comprises an Associate Forester, who acts mainly as an executive assistant, and several Assistant Foresters who have charge of the various branches of the Service; i. e., Operation, Timber Management, Range Management, Lands, Engineering, Public Relations and Research.

The National Forests of the United States and Alaska are divided arbitrarily into ten Regions. The office of each Region is in charge of a Regional Forester. Mr. C. J. Buck is the Regional Forester for the North Pacific Region or Region 6, which comprises Oregon, most of Washington, and a small portion of California. On his staff are a number of Assistant regional Foresters who direct the work being done by the various branches corresponding to the Washington office subdivisions.

The Regions again are divided into units called National Forests, (never call them "forest reserves") each in charge of a Forest Supervisor. His office usually includes an Assistant Supervisor, an Executive Assistant or Chief Clerk, and may include additional men who might be called specialists in fire control, road and trail construction, timber sales or other activities. There are 20 National Forests in Region 6.

In Washington: Chelan, Columbia, Colville, Mt. Baker, Olympic, Snoqualmie and Wenatchee.

In Oregon: Deschutes, Fremont, Malheur, Mt. Hood, Ochoco, Rogue River, Siskiyou, Siuslaw, Umpqua, Wallowa, Willamette and Whitman.

In Washington and Oregon: Umatilla.

One part of the Siskiyou National Forest in southern Oregon extends into northern California but is included in Region 6. The Kaniksu N. F. in northeastern Washington is administered by the Northern Region from the headquarters in Missoula, Montana.

The smallest administrative unit is the Ranger District. This is a subdivision of a National Forest and is in charge of a District Ranger. He may be assisted by an Assistant Ranger who helps with the general work but who oftentimes handles some particular phase of the work such as fire control.

All of these men are under Civil Service appointment. That is, they have passed a competitive examination to determine their fitness for Forest Service work.

The forest supervisor and the forest ranger are the two men who come most in contact with the public. The supervisor has charge of a National Forest with an average area of from a million to a million and a half acres. He is charged with the management of this forest under the basic principle of the Forest Service, known as the "highest use". He determines the "most productive use for the permanent good of the whole people".

Out of this principle has come what is known as the "multiple use" plan of forest management. The forest supervisor may find that one part of the forest crop is ripe and needs to be cut into saw logs; and that some sawmill needs these logs to provide industry for the support of a community. The timber is advertised and sold, and the management plans provide for raising a new crop of trees for the future. It may be that some of his territory is "protection forest", regulating a stream flow for drinking water, irrigation, power, and navigation. Producing meat, wool, and leather by allowing the grazing of sheep and cattle sometimes is the highest use; or again it may be recreation and the protection of scenic beauty. In each case the supervisor determines the various uses after careful study, and then coordinates or correlates them in the interests of the "greatest good to the greatest number".

The forest ranger is the "keyman" of the Forest Service. In contact with the local public, and responsible for a forest area of from 150,000 to 400,000 acres, he transacts much of the business of the Service on the ground.

His work is varied and interesting. It may include: Timber sale work, such as cruising, scaling, marking, and enforcement of forest protection provisions; regulating the use of forest range by sheep and cattle which the stockmen bring into the National Forest under permit; laying out and building trails, roads, bridges, telephone lines, lookout houses and other forest improvements; surveying and recreation planning; and compiling data for necessary reports and statistics.

More important than any of these lines of work, at present, is the duty of protecting his part of the forest from fire. He must plan for his fire season with all the care of a general before going into battle. He must have his men, tools and supplies organized, and know where he can get reinforcements; arrange for transport and lines of communication. see that his lookout and patrol system is effective; and be ready to start for any forest fire in his district, day or night, and see that it is fought promptly. His main effort is to keep forest fires from starting by showing the public how to be careful with fire, and by securing the active help of his local community.

The forest ranger must be a good woodsman, and know how to use the tools of a woodsman. He has to know how to pack supplies, sometimes on a horse, sometimes on his own back, and to give first aid to injured fire fighters. He must know the woods, its tree species, the forage plants and something of forest-destroying insects and fungi. He should know the habits of the forest creatures. He must have good mental and physical health, and be able to "rough it". By reason of what he has accomplished in safeguarding the forest resources of the nation, the forest ranger has come to be known as a highly useful citizen and public officer.

Four to six months each summer, during the fire season, the Ranger is assisted by a number of men who form the Short Term Protective Organization. These men do not take a competitive examination, have no Civil Service rating, and therefore do not have retirement or pension privileges. They are, for the most part, local men well-versed in woodsmanship, or forest school students. These men function in such capacities as lookouts, firemen, patrolmen, packers, road and trail workers, or protective assistants (ranger's assistants). Each one is a definite cog in the organization which provides for fire protection and improvement work.

It follows naturally that employment in the Summer Protective Force cannot be considered as a sole means of obtaining a livelihood. It is merely short-term employment for men who usually have other work during the remainder of the year.

What are the chances for getting into the Forest Service? There is just about one reasonably sure avenue. Go to one of the good forest schools and prepare for the Junior Forester's or Junior Range Examiner's examination. Because of the technical nature of these examinations, it is practically impossible to pass without four years of technical training.

3. The States.

a. Washington. The central forestry authority of the State of Washington is vested in the Division of Forestry, of the Department of Conservation and Development.

The executive organization consists of the State Supervisor of Forestry and his staff, at Clympia, and a force of law enforcement officers and state fire wardens. In addition to the fire wardens employed by the State, there are a number of cooperating forces employed by private timber owners and associations. All United States Forest Service rangers are appointed Deputy State Fire Wardens without extra pay.

The principal activities of the State forces at present are forest protection and forest fire prevention, and enforcement of the State forest fire laws. There is cordial cooperation between the State, the Federal Government, and the private timber owners' associations.

At the University of Washington, Seattle, the State maintains an excellent school of forestry, and courses in forestry and range management are given also at Washington State College, Pullman, Washington. These schools are among several in the United States which are making important contributions to forestry by turning out technically and practically trained foresters and grazing specialists.

The College of Forestry at the University is housed in a special building, Anderson Hall, one of the largest and most up-to-date forestry buildings in the United States. The institution has a school forest, a tract of 2,000 acres on the Rainier National Park Highway, a short distance east of La Grande. This area was donated to the College by Charles Lathrop Pack as a demonstration forest. Plans are carried out to make this a "show window of forestry", a tract in which present and future methods of forestry can be graphically portrayed. This includes a model tree nursery, sample plots for the study of tree growth, areas of young and old timber, and examples of natural regeneration. At the present time the forest contains over 25 million feet of standing timber, including young and old growth.

Through the provisions of section 4 of the Federal Reforestation Act, the Federal Government assists in the cost of operating a nursery on the campus of the State College of Washington at Pullman. Here planting stock is raised for distribution to farmers to be used for windbreak and shelterbelt planting. Federal money was first available for this nursery in the spring of 1926, and that year approximately 2,000 seedlings were distributed to farmers. A much larger number of trees has been available for distribution in later years. The nursery at present contains about five acres of ground, and is administered by the State College.

There are 1,248,000 acres of State forest lands in Washington, from which the timber may be harvested; the land cannot be sold. The law of 1923 established a State Forest Board, authorized an issue of $200,000 utility bonds, and established a forest development fund. The object of this law was to formulate a State forest policy; to aid in the reforestation of denuded forest lands; and to provide for the administration of State forests.

b. Oregon. The central forestry agency of the State of Oregon is the State Board of Forestry. This board consists of the Governor of the State, the Dean of the Forest School of Oregon State College, and representatives of the Oregon State Grange, the U. S. Forest Service, the Oregon Forest Fire Association, the West Coast Lumbermen's Association, and the Oregon Wool Growers Association.

The executive organization consists of the State Forester and his staff, at Salem, and a force of law enforcement officers and State fire wardens. In addition to the fire wardens employed by the State, there are a number of cooperating forces employed by private timber owners and associations. All United States Forest Service rangers hold appointments as Deputy State Fire Wardens, without extra pay.

The principal activities of the State forces at present are forest protection and fire prevention, and enforcement of the State forest fire laws. There is the heartiest cooperation between the State, the Federal Government, and private timber owners associations.

At Oregon State College, Corvallis, the State maintains an excellent school of forestry. This school is one of several in the United States which is making important contributions to forestry by turning out technically and practically trained foresters. Since 1926 the school has acquired about 2,200 acres for an arboretum and school forest. Here experiments and studies are being carried on with native tree species to learn more about their habits of growth and characteristics. Promising new species are tried out in an attempt to add to the list of Oregon's valuable woods. Experiments are carried on here which seek new and better methods of management for Douglas fir and associated species. Aside from its economic value, this forest tract and arboretum already has become an interesting spot for foresters, botanists and tree lovers.

Negotiations were completed in 1930 between the U. S. Forest Service and the State Forester whereby the State of Oregon now has a State Forest. This area of some 70,000 acres is located in the Coast Range, south of the Umpqua River, in Coos and Douglas Counties, known as the Elliott State Forest, named in honor of Frank A. Elliott, who served as Oregon State Forester from 1911 to 1930.

This area was acquired by the State through an exchange with the Federal Government of scattered State lands in different parts of the State for a tract of Government land within the Siuslaw National Forest. This is Oregon's first State Forest and provides many opportunities for forest school students from Oregon's School of Forestry to gain practical experience in many phases of forest work, such as forest management, protection, improvement, and administration. The Forest is directly in charge of the State Forester.

4. Forest Industries and Associations.

Since most of the merchantable timber of the Pacific Northwest is owned by private interests, these interests become an important factor in any consideration of forestry and reforestation. In every region where lumbering has been the chief industry, the logged-off-land question has been one of the outstanding economic problems. (See "Timber: Mine or Crop?" - U. S. D. A. Yearbook 1922, Separate No. 886 - for a fuller development of this phase of the subject). The logged-off-land problem will become more and more acute in these states as logging progresses. Already some counties are facing the critical stages of the problem.

There are several private associations which figure largely in forestry matters in this Region. The Washington Forest Fire Association with headquarters at Seattle, and the Oregon Forest Fire Association with headquarters at Portland, are made up of private timber owners. These associations cooperate with the State and Federal foresters in protection of the forests from fire, enforcement of the forest fire laws, education for fire prevention, and studies looking to the better handling of the forests.

The Western Forestry and Conservation Association, which includes in its territory the five states of Washington, Oregon, Idaho, Montana, northern California and British Columbia, has made important contributions to the development of forestry in the Pacific Northwest. Its membership consists of representatives of the timber industry in this region. State and federal foresters serve on its committees. "The Western Fire Fighters' Manual" in eight chapters, issued by this association, has become standard for practically all western states, as well as in many other parts of the United States.

The West Coast Lumbermen's Association, composed of logging and mill operators of the Douglas fir region, has been a vital influence in the self-government of the industry in western Washington and Oregon. The principal activities of this association include: mill inspection of lumber, supervision of members' grades

(that is, seeing that the quality of lumber put out is up to the standards marked on the lumber); issuing certificates of inpection in case of a dispute over grades; determining what shall constitute the quality to be included in the various grades; compiling statistics essential to the industry, and keeping the industry informed of market conditions and other important matters.

The Western Pine Association, which includes the logging and mill operators of the pine regions of eastern Washington and Oregon, has many of the same functions as those of the West Coast Lumbermen's Association.

QUESTIONS (Chapter VIII)

1. Name the three agencies working together toward the protection of the forests and forest crops of Oregon and Washington.

2. Explain the Federal Reforestation Act (Clarke-McNary).

3. Why is this act considered the most important forward step along the lines of cooperation in American forestry?

4. Make up a chart or list of the personnel "set-up" of the U. S. Forest Service.

5. How many U. S. Forest regions are there in the United States and Alaska? What is the number of this region? How many national Forests does it contain?

6. What is the "multiple use" plan of forest management? How does it operate for the good of the public?

7. Why is the forest ranger the "keyman" of the Forest Service? Describe his duties.

8. What is the short-term force of the Forest Service?

9. Briefly describe the forestry "set-up" for the state of Washington.

10. Briefly describe the forestry "set-up" for the state of Oregon.

11. Why are private timber interests an important factor in forestry and reforestation in the Pacific Northwest?

12. What are the principal activities of the West Coast Lumbermen's Association?

IX. APPENDIX

I. Brief Historical Outline of the U. S. Forest Service.

1 - On August 16, 1876 Congress appointed Dr. Franklin B. Hough as Commissioner of Forestry.

2 - In 1877 Congress granted its first appropriation of $6,000 for the purpose of obtaining information preparatory to establishing a Division of Forestry.

3 - In 1881 the Division of Forestry was established in the Department of Agriculture as an information bureau only, and an agent was sent to Europe to study forestry there.

4 - In 1884 the duty of making experiments with timber was added to the work.

5 - By Act of Congress March 3, 1891, the President was given power to establish forest reservations.

6 - On March 30, 1891 President Harrison established the Yellowstone Park Timber Land Reserve to be under control of the Land Office.

7 - In 1896 Secretary of Interior requested the National Academy of Science to investigate and recommend a National Forest policy.

8 - By Act of June 4, 1897 the forest reserves were put under administration and from this Act, with subsequent amendments, the Forests are now being administered. The Land Office had charge of administration. The Division of Forestry gave technical advice. The U. S. Geological Survey was charged with surveying and mapping of the Forests.

9. On July 1, 1898 the Division of Forestry employed a total of six clerks and five scientific employees.

10. In 1898 the first field work was done, which consisted of special investigation in connection with lumbering.

11. In 1901 the Division of Forestry was raised to the rank of Bureau, but the change was in name only.

12. By the Act of February 1, 1905 forestry work was consolidated and the forest reserves were transferred to the Department of Agriculture and the work of the Service as we know it today, started.

13 - In July, 1905, the Bureau of Forestry became the Forest Service.

14 - In 1907, the "forest reserves" were changed to National Forests in name, to correct the impression that they were withdrawn from use.

15 - In 1908 the direct administration of field work was transferred from Washington to six regional headquarters in the West; in 1914, a seventh region was established for the Appalachians; in 1921, an eighth region was established in Alaska; and in 1929 a ninth region was set up for the Lake States. In 1934 a tenth region was set up for the South.

16 - Between 1901 and 1909 President Roosevelt set aside over 148,000,000 acres of National Forests.

17 - By Act of March 1, 1911 (Weeks Law), acquisition of forest lands on headwaters of navigable streams east of the Mississippi River made possible. Total of 2,996,234 acres had been purchased up to June 30, 1929, under this act and the Clarke-McNary Act of June, 1924.

18 - On June 7, 1924, the Clarke-McNary Reforestation Act was passed, greatly extending the scope of Government cooperation in forestry.

19 - On May 22, 1928 the Forest Research Act (McSweeney-McNary) was passed. This act correlates all branches of Federal research having to do with forests and gives organic recognition to the several forest experiment stations and other agencies doing forest research.

20 - By the act of March 31, 1933, entitled "An Act for the Relief of Unemployment Through the Performance of Useful Public Work, and for Other Purposes", the Civilian Conservation Corps came into existence. The Forest Service was charged with the selection of camp sites and the supervision of the work projects on national forest, state and private lands. On April 5, 1933, the first 25,000 men were called and by July 29, 1933 the full quota of over 300,000 men were enrolled and established in camps throughout the country.

21 - On July 1, 1933 there were 148 national forests embracing a net area of 162,009,145 acres.

22 - The "National Industrial Recovery Act" of June 16, 1933 called for a code or formulation of the business practice to be used by each industry. "The Code of Fair Competition of the Lumber and Timber Products Industry" was approved by the President

on August 19, 1933. The Forest Service was called upon to advise with the leaders of the industry in the formulation of the Code, more especially in the requirements to be followed under Article X, relating to conservation and woods practice. The functions of the Forest Service have been expanded to provide for general supervision over all the provisions of the Article on Conservation and many other phases of the Code which need federal cooperation.

II. Forestry Laws of Washington and Oregon Summarized.

A. Washington Laws.

1. The first legislation in Washington pertaining to the protection of the forests against fire was enacted in 1891; but prior to 1903 the Legislature had enacted no law authorizing the employment of an active working force of men in the field to protect the timber of the State from fire.

2. In 1903, the Legislature enacted a law making the Commissioner of Public Lands Ex-officio State Forest Fire Warden, and the county commissioners of the several counties Boards of Deputy State Forest Fire Wardens. They were authorized to appoint Deputy Fire Wardens in their respective counties, and to issue burning permits. But Little effective action was taken under this law.

3. In 1905, the Legislature repealed the 1903 law and enacted in its stead the Forest Protection Law. This law created a State Board of Forest Commissioners to be appointed by the Governor and serve without compensation. They were empowered to appoint a State Fire Warden, and to appoint Deputy Fire Wardens in each county. The first board under this law was appointed June 9, 1905, and met and organized June 15, 1905. The State Fire Warden was appointed June 27, and forest protection work started July 1, of that year.

4. In 1911, additional general legislation was enacted which broadened the scope of office and duties of the State Forester and his wardens.

5. In 1917, the compulsory Forest Fire Patrol law was enacted, a progressive measure, requiring every owner of timberland to furnish patrol and protection of such land satisfactory to the State Board of Forest Commissioners. Under this law the State is authorized to levy not to exceed 5¢ per acre for protection on privately-owned forest lands.

6. In 1921 the Legislature passed the Reforestation Act, along with an appropriation of $5,000, which authorized the State to acquire lands suitable for reforestation purposes. Under this act, 9,481 acres of cut-over lands have been acquired, including a gift of 5,004 acres.

7. During 1921, the Legislature also transferred the duties and powers of the Forest Board to the Director of the Department of Conservation and Development, and changed the title of the State Forester and Fire Warden to that of Supervisor of Forestry.

8. In 1923 a State Forest Board was created to formulate a State Forest Policy, - reforestation of denuded lands, and administration of State Forests. An issue of $200,000 utility bonds was authorized, and a forest development fund established.

9. In 1925 the Legislature passed several acts relative to forest protection, among which were: Provision for a closed season for burning forest material or debris, and only by written permit; penalties for negligently allowing forest fires to spread, or maliciously setting fires; prohibiting public camping, except on designated and prepared campgrounds and requiring campfire permits elsewhere; requiring owners of forest lands to provide protection for them; penalties against throwing any lighted or burning material from any moving vehicle; closure of extra hazardous areas.

10. In 1927 the Legislature provided for issuance of certicicates of clearance to loggers, lumbermen and others who have disposed of slash and other forest debris or removed the hazard incident thereto.

11. In 1931 the Legislature passed a progressive Reforestation Act or Forest Taxation Law, the main purpose of which is to encourage owners of cut-over lands to hold them for reforestation purposes; this sets up for taxation purposes, an assessed value of $1.00 per acre for lands west of the Cascades and 50¢ per acre for east of the Cascades.

12. In 1931 an act requiring all cars or public conveyances operating through or above forest, range or grain areas to be equipped with suitable ash trays to receive matches, lighted tobacco, cigars, cigarettes or other inflammable material was passed. The act of 1925 was amended to make it unlawful to throw away during the closed season, any lighted or burning material in forest, grain or range land, whether from a moving vehicle or otherwise.

13. In 1933 the Legislature passed the Fire Prevention District Act which provides for the formation of fire protection districts for the protection of property from fire in territories outside of incorporated cities and towns in Class "A" and first class counties upon the submittal of a petition signed by ten per cent of the qualified voters who are property owners. A tax levy to pay the costs of such protection is provided. This act extends fire protection on forest and range lands to smaller units and territories not accessible to already established protective organizations.

B. Oregon Laws.

1 - Prior to 1907 the Oregon Statutes made it the duty of the State Game and Forest Warden "to enforce the laws of the State of Oregon for the Protection of Forests".

2 - In 1907 the Legislature passed a law providing for a non-political State Board of Forestry. For the first time the State had an organization charged exclusively with the administration of the forestry laws.

3 - In 1911, a Forestry Law was passed providing for a State Forester and carrying a substantial appropriation.

4 - In 1913 the Compulsory Forest Patrol Law was passed, requiring timber land owners to provide forest fire patrol for their holdings.

5 - In 1921 a law was passed which declared Forest Insect Pests, Insect Infestations and Pine Beetles a nuisance, and provided for their control, eradication and destruction.

6 - In 1923, the Legislature enacted a Fire Prevention Equipment statute providing for adequate forest fire-fighting equipment on logging operations and at sawmills.

7 - In 1925, the Revised Forestry Code was passed, consolidating the State's Forestry laws, strengthening weak points, and eliminating faults which had made enforcement of the law difficult.

8 - In 1926, the State Forestry Code was strengthened in several respects, mainly to make cumulative the responsibility of various landowners on whose property a fire may have burned;

and then no longer requiring proof of "the intent" in the mind of the person responsible for starting a fire on another's property.

9 - In 1929 the Legislature passed a progressive Reforestation or Forest Taxation Law, which provides for the classification of land and an annual forest fee or land tax of 5¢ per acre on cut-over or potential forest land, and a yield tax of 12½¢ to be levied when the first forest crop was cut from such land.

10 - In 1931 the Legislature passed an Act which authorized the State Board of Forestry to acquire title to forest lands through gift, purchase or transfer of title to the state by the counties. However, the bill states that no land can be acquired by purchase until specific appropriations are made by the Legislature for the specific purpose. The state in acquiring land under the bill takes the same status as the private forest land owner who is under the provisions of the Reforestation Law. The state is to pay to the county an annual fee of five cents per acre for all lands acquired under the act and 12½ per cent of the yield tax at the time of harvesting crops. The balance of the income is to go into the irreducible school fund.

QUESTIONS (Appendix)

WASHINGTON.

1. In what year was the Forest Protection Law enacted and how did it operate?
2. Name and explain the law of 1917.
3. What steps concerning titles did the Legislature take in 1921?
4. In 1925 the Legislature passed several acts relative to forest protection of state lands. Name them.
5. Why is the law of 1931 so important?
6. Explain the Fire Prevention District Act of 1933.

OREGON

1. What law did the Legislature pass in 1907?
2. In what year was the title of State Forester provided for?
3. Explain briefly the laws enacted, with dates, from 1913 to 1926 inclusive.

4. What was the Forest Taxation Law of 1929?

5. Under the act of 1931 how does the state at present acquire forest lands?

III. References

1. "Economics of Forestry", B. E. Fernow, LL.D., Crowell & Co.

2. "United States Forest Policy", John Ise, Ph. D., LL.B., Yale Press.

3. "Forests and Mankind", Pack & Gill, Macmillan, 1929.

4. "The Training of a Forester", Gifford Pinchot, Lippincott.

5. "Our National Forests", R. H. D. Boerker, Ph. D., Macmillan Co.

6. "The Development of Governmental Forest Control in the United States", by Jenks Cameron.

7. "Trees and Forests of Western United States", by Edward J. Pamplik, 430 Main Post Office Bldg., Portland, Oregon, 1928.

8. "Forest Facts for Schools", Pack & Gill, Macmillan, 1931.

9. "Economic Resources of the Pacific Northwest", Chap. VIII, By Hugo Winkenwerder, M. F., Lowman & Hanford.

10. "Handbook of Field & Office Problems in Forest Mensuration", by Hugo Winkenwerder, M. F., and E. T. Clark, M. F., Wiley.

11. "Short Keys to the Trees of Oregon and Washington" (Pamphlet), by Hugo Winkenwerder, University of Washington.

12. "Forestry in the Pacific Northwest", by Hugo Winkenwerder, M. F., American Tree Association, 1928.

13. "Washington Forest Fire Laws", State Supervisor of Forestry, Olympia, Wn.

14. "Oregon's Commercial Forests", Geo. W. Peavy, M. S. F., Dean, School of Forestry, Oregon State College.

15. "Forest Education", Graves and Guise, New Haven, Yale University Press, 1932.

16. "The Principles of Handling Woodlands", H. S. Graves, John Wiley & Sons, N. Y., 1911.

17. "The Practice of Silviculture", Ralph C. Hawley, Prof., of Forestry, Yale University, 1929.

18. "Elements of Forestry", Second Edition, Moon & Brown, John Wiley & Sons, N. Y., 1929.

19. "General Forestry", Nelson C. Brown, John Wiley & Sons, New York, N. Y., 1935.

Government Bulletins:

1. "A Forest Fire Prevention Handbook for the Schools of Washington", Misc. Publ., #40, 1928.

2. "Forestry Clubs for Young People", Misc. Publ. #45.

3. "Timber: Mine or Crop?" U. S. Department of Agriculture Yearbook for 1922, Y. B. Separate #886.

4. "Government Forest Work", Department of Agriculture Cir. #211.

5. "Report of the National Conference on Utilization of Forest Products", Nov. 19, 1924, U. S. Department of Agriculture Misc., Cir. #39.

6. "American Forests & Forest Products", U. S. Department of Agriculture Statistical Bulletin #21.

7. "Our Forests", U. S. Department of Agriculture Misc. Publication #162.

8. "Timber Growing and Logging Practice in the Douglas Fir Region", by T. T. Munger, U. S. Department of Agriculture Bulletin #1493.